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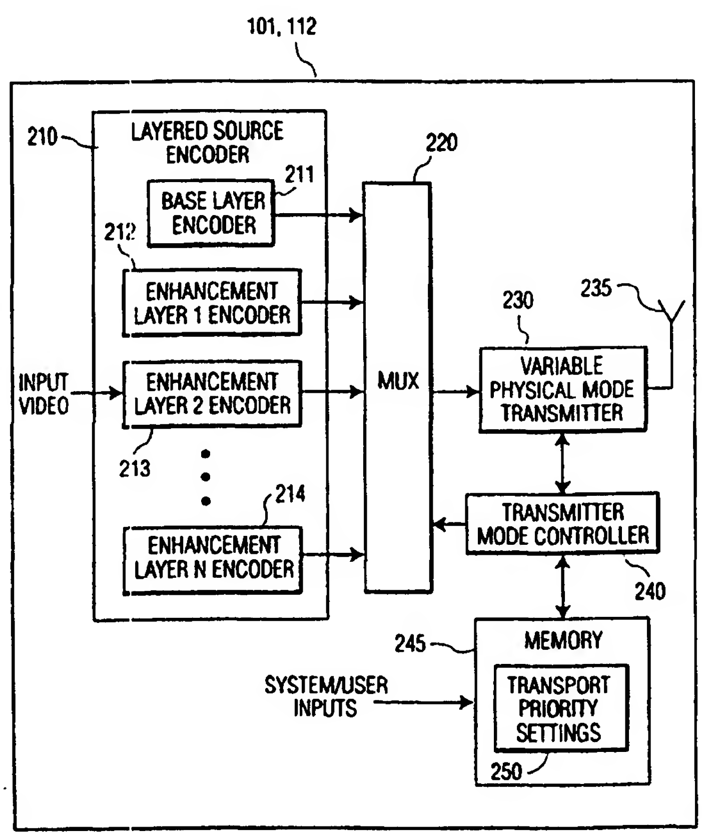

(57) Abstract: There is disclosed a wireless communication device capable of receiving an incoming RF data signal and generating therefrom a base layer data stream and at least one enhancement layer data stream. The wireless communication device comprises: 1) a base layer decoder; 2) at least one enhancement layer decoder; 3) a variable mode receiver for demodulating the RF incoming RF data signals in a plurality of physical modes, such as BPSK, QPSK, QAM, and the like, and at a plurality of code rates and 4) a receiver mode controller for controlling the physical modes of the variable mode receiver. The receiver mode controller causes a first demodulated output signal of the variable mode receiver to be transferred to the base layer decoder when the variable mode receiver is operating in a first physical mode and causes a second demodulated output signal of the variable mode receiver to be transferred to the at least one enhancement layer decoder when the variable mode receiver is operating in a second physical mode.

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System and method for improving video transmission over a wireless network

TECHNICAL FIELD OF THE INVENTION

The present invention is directed, in general, to video encoding systems and, more specifically, to an encoding system for transmitting streaming video in a wireless network.

BACKGROUND OF THE INVENTION

Real-time streaming of multimedia content in wireless networks has become an increasingly common application in recent years. A wide range of interactive and non-interactive multimedia applications, such as news-on-demand, live network television viewing, video conferencing, among others, rely on end-to-end streaming video or audio techniques. Unlike a downloaded video or audio file, which may be retrieved first in non-real time and viewed or played back later in real time, streaming video and audio applications require a transmitter that encodes and transmits a video or audio signal over a data network to a receiver, which must decode and display the video or audio signal in real time.

In a wireless network, it is important priority that video bit streams be delivered as reliably as possible. Layered source coding is one of the most effective schemes used to provide video transport systems with error resilience. In the layered source coding scheme, video data information is decomposed into a number of layers, each representing different perceptually relevant components of the video source. The base layer, which contains the most essential video information, can be used to generate a basic output video signal with an acceptable quality. A higher quality video signal can then be obtained by retrieving data from one or more enhancement layers that further improve the basic output video signal generated by the base layer encoder.

There are different ways for implementing layered source coding. For example, in systems with temporal domain layered coding, the base layer contains a bit stream with a low video frame rate and the enhancement layers contain incremental information for obtaining higher frame rates than possible with the original base layer. In systems with spatial domain layered coding, the base layer provides sub-sampled version

codes for the original video sequence and the enhancement layers contain additional information for obtaining higher spatial resolution at the decoder.

In general, the different transport layers use different data streams with distinctly different tolerances for errors (known as channel errors) which are introduced during transport. To combat channel errors, the layered coding technique is usually combined with transport prioritization so that the base layer is delivered with a higher degree of error protection than the enhancement layers.

Transport prioritization has been implemented in a number of different ways in the prior art. One common transport prioritization method for wireless networks combines layered coding with different power levels so that each sub-stream transport layer is sent at a different transmit power level. The most important layer, the base layer is transmitted at highest power and the enhancement layers are transmitted at lower power, so that the overall power is kept within regulatory limits. The disadvantage to this method is that the finest levels of detail in the enhancement layers are transmitted at the lowest power.

In other conventional prioritization schemes, the base layer may be error checked and re-transmitted as often as necessary to ensure that it is properly received. Unfortunately, the re-transmission of the base layer occurs at the expense of transmission of the enhancement layer data.

There is therefore a need in the art for improved encoders and decoders for use in wireless networks capable of supporting real time data transmission to a mobile station, such as a video or audio receiver, a wireless computer, and the like. In particular, there is a need for improved encoders and decoders that are less susceptible to physical transport layer errors in streaming video and audio applications. More particularly, there is a need for encoders and decoders which deliver higher priority layered data using more reliable transmission modes and lower priority layered data using less reliable transmission modes.

SUMMARY OF THE INVENTION

To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide a wireless communication device capable of receiving an incoming RF data signal and deriving from the incoming RF data signal a base layer data stream and at least one enhancement layer data stream. In an advantageous embodiment of the present invention, the wireless communication device comprises: 1) a base layer decoder, 2) at least one enhancement layer decoder, 3) a variable mode receiver capable of demodulating the RF incoming RF data signals in a plurality of physical modes,

and 4) a receiver mode controller capable of controlling the plurality of physical modes of the variable mode receiver, wherein the receiver mode controller causes a first demodulated output signal of the variable mode receiver to be transferred to the base layer decoder when the variable mode receiver is operating in a first physical mode and causes a second demodulated output signal of the variable mode receiver to be transferred to the at least one enhancement layer decoder when the variable mode receiver is operating in a second physical mode.

According to one embodiment of the present invention, a bit error rate of the first physical mode is lower than a bit error rate of the second physical mode.

According to another embodiment of the present invention, the at least one enhancement layer decoder comprises a first enhancement layer decoder and a second enhancement layer decoder.

According to still another embodiment of the present invention, the receiver mode controller causes the second demodulated output signal of the variable mode receiver to be transferred to the first enhancement layer decoder when the variable mode receiver is operating in a second physical mode and causes a third demodulated output signal of the variable mode receiver to be transferred to the second enhancement layer decoder when the variable mode receiver is operating in a third physical mode.

According to yet another embodiment of the present invention, a bit error rate of the second physical mode is lower than a bit error rate of the third physical mode.

According to a further embodiment of the present invention, the plurality of physical modes comprise at least two of binary phase shift keying modulation, quadrature phase shift keying modulation, and quadrature amplitude modulation.

According to a still further embodiment of the present invention, the plurality of physical modes comprise a plurality of code rates.

According to a yet further embodiment of the present invention, the incoming RF data signal comprises a video signal.

According to another embodiment of the present invention, the incoming RF data signal comprises an audio signal.

It also is a primary object of the present invention to provide a wireless communication device capable of transmitting an outgoing RF data signal comprising a base layer data stream and at least one enhancement layer data stream. In an advantageous embodiment of the present invention, the wireless communication device comprises: 1) a base layer encoder, 2) at least one enhancement layer encoder, 3) a variable mode transmitter

capable of modulating an input signal in a plurality of physical modes to thereby produce the outgoing RF data signal; and 4) a transmitter mode controller capable of controlling the plurality of physical modes of the variable mode transmitter, wherein the transmitter mode controller causes the variable mode transmitter to transmit a base layer output signal from the base layer encoder in a first physical mode and causes the variable mode transmitter to transmit at least one enhancement layer output signal from the at least one enhancement layer encoder in a second physical mode.

In one embodiment of the present invention, a bit error rate of the first physical mode is lower than a bit error rate of the second physical mode.

In another embodiment of the present invention, the at least one enhancement layer encoder comprises a first enhancement layer encoder and a second enhancement layer encoder.

In still another embodiment of the present invention, the transmitter mode controller causes the variable mode transmitter to transmit a first enhancement layer output signal from the first enhancement layer encoder in the second physical mode and causes the variable mode transmitter to transmit a second enhancement layer output signal from the second enhancement layer encoder in a third physical mode.

In yet another embodiment of the present invention, a bit error rate of the second physical mode is lower than a bit error rate of the third physical mode.

In a further embodiment of the present invention, the plurality of physical modes comprise at least two of binary phase shift keying modulation, quadrature phase shift keying modulation, and quadrature amplitude modulation.

In a still further embodiment of the present invention, the plurality of physical modes comprise a plurality of code rates.

In a yet further embodiment of the present invention, the incoming RF data signal comprises a video signal.

According to another embodiment of the present invention, the incoming RF data signal comprises an audio signal.

The foregoing has outlined rather broadly the features and technical advantages of the present invention so that those skilled in the art may better understand the detailed description of the invention that follows. Additional features and advantages of the invention will be described hereinafter that form the subject of the claims of the invention. Those skilled in the art should appreciate that they may readily use the conception and the specific embodiment disclosed as a basis for modifying or designing other structures for

carrying out the same purposes of the present invention. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the invention in its broadest form.

Before undertaking the DETAILED DESCRIPTION, it may be advantageous to set forth definitions of certain words and phrases used throughout this patent document: the terms "include" and "comprise" and derivatives thereof mean inclusion without limitation; the term "or" is inclusive, meaning and/or; the phrases "associated with" and "associated therewith" and derivatives thereof, may mean to include, be included within, interconnect with, contain, be contained within, connect to or with, couple to or with, be communicable with, cooperate with, interleave, juxtapose, be proximate to, be bound to or with, have, have a property of, or the like; and the term "controller" means any device, system or part thereof that controls at least one operation, such a device may be implemented in hardware, firmware or software, or some combination of at least two of the same. It should be noted that the functionality associated with any particular controller may be centralized or distributed, whether locally or remotely. Definitions for certain words and phrases are provided throughout this patent document, those of ordinary skill in the art should understand that in many, if not most instances, such definitions apply to prior, as well as future uses of such defined words and phrases.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, wherein like numbers designate like objects, and in which:

FIGURE 1 illustrates a general overview of an exemplary wireless network with streaming video or audio capability according to one embodiment of the present invention;

FIGURE 2 illustrates a view of selected portions of the mobile stations and the base stations in the exemplary wireless network in FIGURE 1 that perform layer source encoding according to one embodiment of the present invention;

FIGURE 3 illustrates a view of selected portions of the mobile stations and the base stations in the exemplary wireless network in FIGURE 1 that perform layered source decoding according to one embodiment of the present invention; and

FIGURE 4 is a flow chart illustrating communications between an exemplary base station and mobile station according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIGURES 1 through 4, discussed below, and the various embodiments used to describe the principles of the present invention in this patent document are by way of illustration only and should not be construed in any way to limit the scope of the invention. Those skilled in the art will understand that the principles of the present invention may be implemented in any suitably arranged wireless network.

FIGURE 1 illustrates a general overview of wireless network 100 with streaming video and/or audio capability. For the sake of simplicity in explaining the principles of the present invention, the majority of the description that follows will discuss the transmission of a real time video signal from a base station to a mobile station or from one mobile station to another mobile station. However, it should be clearly understood that the principles of the present invention are by no means limited to the wireless transmission of video signals. In fact, a transport priority system according to the principles of the present invention may be used to transmit and to receive any type of layered data having different levels of priority between layers, including streaming video signals, streaming audio signals, and other types of layered real time signals.

Wireless network 100 comprises streaming video server 120, base stations (BS) 101 and 102, and mobile stations (MS) 111, 112, 113, and 114. Wireless network 100 may be any suitable network that communicates according to the IEEE 802.11a wireless network standard. Wireless network 100 may include portions of both public data networks, such as the Internet, and private data networks, such as an enterprise-owned local area network (LAN) or wide area network (WAN).

Streaming video server 120 operates in wireless network 100 to transfer real time video frames to BS 101 and BS 102. Streaming video server 120 may be any one of a wide variety of video sources including a data network server, a cable network, a desktop personal computer (PC), or the like. BS 101 and BS 102 receive streaming video data, such as MPEG-4 or the like, from streaming video server 120 and transmit it to MS 111-114. BS 101 and BS 102 may transmit the layered data according to priority level to MS 111-114. Each of MS 111-114 may comprise any suitable wireless device for communicating with BS 101 or BS 102 or, in some cases, each other, including television receivers, radio receivers, cellular telephones, portable computers, personal communication system (PCS) devices, and the like. One or more of MS 111-114 may be capable of decoding and displaying video data received from wireless network 100. In addition, two or more of mobile stations 111-114 may also be capable of communicating directly with each other

without transmitting through BS 101 or BS 102. This capability to communicate with each other includes the capability to encode and to decode layered video data and to transmit and to receive the same.

FIGURE 2 illustrates a selected transmission portion of exemplary base station 101 and exemplary mobile station 112 that performs layered video source encoding according to one embodiment of the present invention. The selected transmission portion of exemplary BS 101 and MS 112 comprises layered source encoder 210, multiplexer 220, variable physical mode transmitter 230, antenna 235, transmitter mode controller 240, and memory 245, which stores transport priority settings 250. Layered source encoder 210 further comprises base layer encoder 211, and N enhancement layer encoders, including exemplary enhancement layer encoders 212-214 (arbitrarily labeled Enhancement Layer 1 Encoder, Enhancement Layer 2 Encoder, and Enhancement Layer N Encoder, respectively).

Layered source encoder 210 receives the input video signal and encodes the input video signal into a base layer and up to N enhancement layers. The base layer has the highest priority level and enhancement layer 1 has the next highest priority level. Enhancement layer N has the lowest priority level. Base layer encoder 211 encodes the base layer data stream in compliance with MPEG-4, for example. In a similar manner, enhancement layer encoder 212, enhancement layer encoder 213, and enhancement layer encoder 214 independently encode additional enhancement layer video streams. Multiplexer 220 receives the encoded base layer data stream and one or more encoded enhancement layer data streams from layered source encoder 210. Multiplexer 220, under the control of transmitter mode controller 240, may sequentially multiplex the encoded base layer data stream and up to N encoded enhancement data layers to produce an input data steam to variable physical mode transmitter 230.

Variable physical mode transmitter 230, operating under the control of transmitter mode controller 240, modulates each layer of the data stream from multiplexer 220 according to the physical mode selected by transmitter mode controller 240. The physical mode for each layer is determined by the priority level of the respective layer. The output of variable physical mode transmitter 230 is transmitted to the mobile stations by antenna 235. Transmitter mode controller 240 controls the operation of multiplexer 220 and variable physical mode transmitter 230 according to system-defined or user-defined transport priority settings 250 in memory 245.

Transmitter mode controller 240 operates in response to transport priority settings 250 to cause BS 101 or MS 112 to switch data from multiplexer 220 according to

different priority levels and in compliance with IEEE 802.11a standard for wireless networks. IEEE 802.11a is selected for this embodiment since it supports data packet transmission with different modulation and error protection schemes and at different data rates, as illustrated in Table 1. As shown, transmitter mode controller 240 also provides an output signal which conforms with requirements for 64-carrier orthogonal frequency division multiplex (OFDM) radio networks.

PHYSICAL MODE	DATA RATE (Mbps)	RELIABILITY INDEX
BPSK -Code Rate=1/2	6	very very high
BPSK -Code Rate=3/4	9	very high
QPSK -Code Rate=1/2	12	high
QPSK -Code Rate=3/4	18	medium
16QAM -Code Rate=1/2	24	low
16QAM -Code Rate=3/4	36	very low
64QAM -Code Rate=3/4	54	very very low

TABLE 1

The duration of one OFDM symbol is equal to 4 microseconds. In Table 1, BPSK means binary phase shift keying; QPSK means quadrature phase shift keying; and QAM means quadrature amplitude modulation.

Transport priority settings 250 maps each encoded data stream output by layered source encoder 210 according to its priority level and to a comparable reliability index and physical mode supported by IEEE 802.11a networks. A physical mode in this scenario equates to a different modulation technique.

An exemplary transport priority settings 250 mapping of different priority source code layers to the physical transport modes is shown below in Table 2. Thus, physical mode transmitter 230 transmits each layer from multiplexer 220 according to Table 2. The most important layered data streams (e.g., Base Layer and Enhancement Layer 1) are transmitted in physical modes that have the highest reliability (i.e., lowest error rate). Less important layered data streams (e.g., Enhancement Layer 2, Enhancement Layer 3, etc.) are transmitted in physical modes that have lower reliability indexes (i.e., higher error rate), but higher data transmission rates.

CODED LAYER	PHYSICAL MODE	DATA RATE (Mbps)	RELIABILITY INDEX
Base Layer	BPSK Code Rate=1/2	6	very very high
Enhancement Layer 1	BPSK Code Rate=3/4	9	very high
Enhancement Layer 2	QPSK Code Rate=1/2	12	high
Enhancement Layer 3	QPSK Code Rate=3/4	18	medium
Enhancement Layer 4	16QAM Code Rate=1/2	24	low
Enhancement Layer 5	16QAM Code Rate=3/4	36	very low
Enhancement Layer 6,7,...	64QAM Code Rate=3/4	54	very very low

TABLE 2

FIGURE 3 illustrates a selected receiver portion of exemplary base station 101 and exemplary mobile station 112 that performs layered video source decoding according to one embodiment of the present invention. The selected receiver portion of BS 101 and MS 112 receives and decodes an incoming RF signal data conforming to the characteristics described in Table 2, reversing the process described for FIGURE 2 to create an output video signal (output video) which approximates the original input video.

The selected portion of BS 101 and MS 112 comprises antenna 305, variable physical mode receiver 310, receiver mode controller 315, de-multiplexer (demux) 320, layered source decoder 330, and memory 340, which stores transport priority settings 345. Layered source decoder 330 further comprises base layer decoder 331, and N enhancement layer decoders, including exemplary enhancement layer decoders 332-334 (arbitrarily labeled

Enhancement Layer 1 Decoder, Enhancement Layer 2 Decoder, and Enhancement Layer N Decoder, respectively).

Variable physical mode receiver 310, operating under the control of receiver mode controller 315, demodulates the incoming RF signal from antenna 305 in a plurality of physical modes in order to generate base layer and enhancements layer data streams for transfer to demultiplexer 320. Receiver mode controller 315 controls the operation of demultiplexer 320 and variable physical mode receiver 310 as directed by transport priority settings 345 in memory 340. For instance, as the base layer RF signal is being received, variable physical mode receiver 310 demodulates the base layer RF signal in the same physical mode in which the base layer data stream was modulated. Next, when the Enhancement Layer 1 RF signal is being received, variable physical mode receiver 310 switched physical modes and demodulates the Enhancement Layer 1 RF signal in the same physical mode in which the Enhancement Layer 1 data stream was modulated. Receiver mode controller 315 causes demultiplexer 320 to switch the base layer data stream and enhancement layer data streams generated by variable physical mode receiver 310 to the corresponding base layer decoder or enhancement layer decoder according to the priority levels set forth in Table 2. The decoded base layer and enhancement layer data streams are combined in layer source decoder 330 to produce an output video signal that approximates the original input video signal.

In an alternate embodiment of present invention, variable physical mode transmitter 230 and variable physical mode receiver 310 may be configured to transfer the base layer of video data in the second best physical mode available in IEEE 802.11a (e.g., BPSK, code rate = 3/4, 9 Mbps) with each enhancement layer being transferred at the sequentially lower level priority scheme. For instance, variable physical mode transmitter 230 and variable physical mode receiver 310 may transmit enhancement layer 1 data at QPSK with code rate = 1/2 and at 12 Mbps. This enhancement layer 1 transfer equates to data transfer with a high reliability index instead of a very high reliability index.

Various other embodiments are available using different combinations of transmit priority levels available with IEEE 802.11a. In an alternate embodiment of the present invention, variable physical mode transmitter 230 may be replaced by N+1 RF transmitters, each of which modulates and transmits either the base layer data stream or one of the enhancement layer data streams. Similarly, variable physical mode receiver 310 may be replaced by N+1 RF receivers, each of which receives and demodulates either an incoming base layer RF signal or one of the incoming enhancement layer RF signals.

FIGURE 4 depicts flow chart 400, which illustrates the operation of exemplary BS 101 and MS 112 according to one embodiment of the present invention. First, layered source encoder 210 encodes the input video signal received by BS 101 into a compressed base layer stream and up to N compressed enhancement layers streams (process step 405). Next, multiplexer 220 transfers the encoded base layer stream and up to N enhancement layer streams to variable physical mode transmitter 230, as directed by transmitter mode controller 240.

Operating under the direction of transmitter mode controller 240, variable physical mode transmitter 230 modulates and transmits the encoded base layer stream through antenna 235 to network 100, using the most reliable physical transmission mode (e.g., BPSK with code rate = 1/2) (process step 410).

Transmitter mode controller 240 then causes variable physical mode transmitter 230 to separately modulate and transmit up to N enhancement layer streams using different physical transmission modes. Transmitter mode controller 240 assigns the physical transmission mode for each sequential enhancement layer stream with a descending order of reliability when compared to the base layer and each other. For example, enhancement layer 1 stream may be transmitted in BPSK with a code rate equal to 3/4, which is lower than the reliability rate associated with the base layer stream. This may be followed by transmission of enhancement layer 2 stream in lower reliability QPSK with a code rate equal to 1/2, enhancement layer 3 stream in QPSK with a lower reliability code rate equal to 3/4, and so forth (process step 415).

Next, variable physical mode receiver 310 in MS 112 receives the encoded base layer stream through antenna 305. Variable physical mode receiver 310, operating under the direction of receiver mode controller 315, demodulates the base layer stream according to how it was transmitted (e.g., BPSK with a code rate equal to 1/2) (process step 420). Next, variable physical mode receiver 310 receives and demodulates up to N enhancement layer streams according to the appropriate physical transmission mode as described for BS 101 (process step 425). Variable source decoder 330 receives the base layer stream and up to N enhancement layer streams from variable physical mode receiver 310 through demultiplexer 320. Variable source decoder 330 decodes the base layer stream and up to N enhancement layer streams to generate a recovered output video signal which corresponds with the input video signal as originally received by BS 101 (process step 430).

Although the present invention has been described in detail, those skilled in the art should understand that they can make various changes, substitutions and alterations herein without departing from the spirit and scope of the invention in its broadest form.

CLAIMS:

1. A wireless communication device (112, 101) capable of receiving an incoming RF data signal and generating from said incoming RF data signal a base layer data stream and at least one enhancement layer data stream, said wireless communication device (112, 101) comprising:

a base layer decoder (331);

at least one enhancement layer decoder (332);

a variable mode receiver (310) capable of demodulating said RF incoming RF data signals in a plurality of physical modes; and

a receiver mode controller (315) capable of controlling said plurality of physical modes of said variable mode receiver (310), wherein said receiver mode controller (315) causes a first demodulated output signal of said variable mode receiver (310) to be transferred to said base layer decoder (331) when said variable mode receiver (310) is operating in a first physical mode and causes a second demodulated output signal of said variable mode receiver (310) to be transferred to said at least one enhancement layer decoder (332) when said variable mode receiver (310) is operating in a second physical mode.

2. The wireless communication device (112, 101) as set forth in Claim 1 wherein said at least one enhancement layer decoder (332) comprises a first enhancement layer decoder (332) and a second enhancement layer decoder (333).

3. The wireless communication device (112, 101) as set forth in Claim 3 wherein said receiver mode controller (315) causes said second demodulated output signal of said variable mode receiver (310) to be transferred to said first enhancement layer decoder (332) when said variable mode receiver (310) is operating in a second physical mode and causes a third demodulated output signal of said variable mode receiver (310) to be transferred to said second enhancement layer decoder (333) when said variable mode receiver (310) is operating in a third physical mode.

4. A wireless communication device (112, 101) capable of transmitting an outgoing RF data signal comprising a base layer data stream and at least one enhancement layer data stream, said wireless communication device (112, 101) comprising:
a base layer encoder (211);
at least one enhancement layer encoder (212);
a variable mode transmitter (230) capable of modulating an input signal in a plurality of physical modes to thereby produce said outgoing RF data signal; and
a transmitter mode controller (240) capable of controlling said plurality of physical modes of said variable mode transmitter (230), wherein said transmitter mode controller (240) causes said variable mode transmitter (230) to transmit a base layer output signal from said base layer encoder (211) in a first physical mode and causes said variable mode transmitter (230) to transmit at least one enhancement layer output signal from said at least one enhancement layer encoder (212) in a second physical mode.

5. The wireless communication device (112, 101) as set forth in Claim 4 wherein said at least one enhancement layer encoder (212) comprises a first enhancement layer encoder (212) and a second enhancement layer encoder (213).

6. The wireless communication device (112, 101) as set forth in Claim 5 wherein said transmitter mode controller (240) causes said variable mode transmitter (230) to transmit a first enhancement layer output signal from said first enhancement layer encoder (212) in said second physical mode and causes said variable mode transmitter (230) to transmit a second enhancement layer output signal from said second enhancement layer encoder (213) in a third physical mode.

7. For use in a wireless communication device (112, 101) capable of receiving an incoming RF data signal comprising a base layer RF signal and at least one enhancement layer RF signal, a method of processing the RF data signal comprising the steps of:
demodulating the base layer RF signal in a first physical mode to thereby generate a base layer data stream;
demodulating the at least one enhancement RF signal in a second physical mode to thereby generate at least one enhancement layer data stream;
decoding the base layer data stream in a base layer decoder (331);

decoding the at least one enhancement layer data stream in at least one enhancement layer decoder (332); and
combining the output of the base layer decoder (331) and the at least one enhancement layer decoder (332) to generate a final output signal.

8. The method as set forth in Claim 7 wherein the at least one enhancement layer decoder (332) comprises a first enhancement layer decoder (332) and a second enhancement layer decoder (333).

9. The method as set forth in Claim 8 wherein the step of demodulating the at least one enhancement RF signal comprises the sub-steps of:
demodulating a first enhancement layer signal in the second physical mode to generate a first enhancement layer data stream; and
demodulating a second enhancement layer signal in a third physical mode to generate a second enhancement layer data stream.

10. For use in a wireless communication device (112, 101) capable of transmitting to at least one receiver an incoming data signal, a method of processing the incoming data signal comprising the steps of
encoding the incoming data signal in a base layer encoder (211) to generate therefrom a base layer data stream;
encoding the incoming data signal in at least one enhancement layer encoder (212) to generate therefrom at least one enhancement layer data stream;
modulating the base layer data stream in a first physical mode to thereby generate a base layer RF signal; and
modulating the at least one enhancement layer data stream in a second physical mode to thereby generate at least one enhancement layer RF signal.

11. The method as set forth in Claim 10 wherein the at least one enhancement layer encoder (212) comprises a first enhancement layer encoder (212) and a second enhancement layer encoder (213).

12. The method as set forth in Claim 11 wherein the step of modulating the at least one enhancement layer data stream comprises the sub-steps of:

modulating a first enhancement layer data stream in the second physical mode to generate a first enhancement layer RF signal; and
modulating a second enhancement layer data stream in a third physical mode to generate a second enhancement layer RF signal.

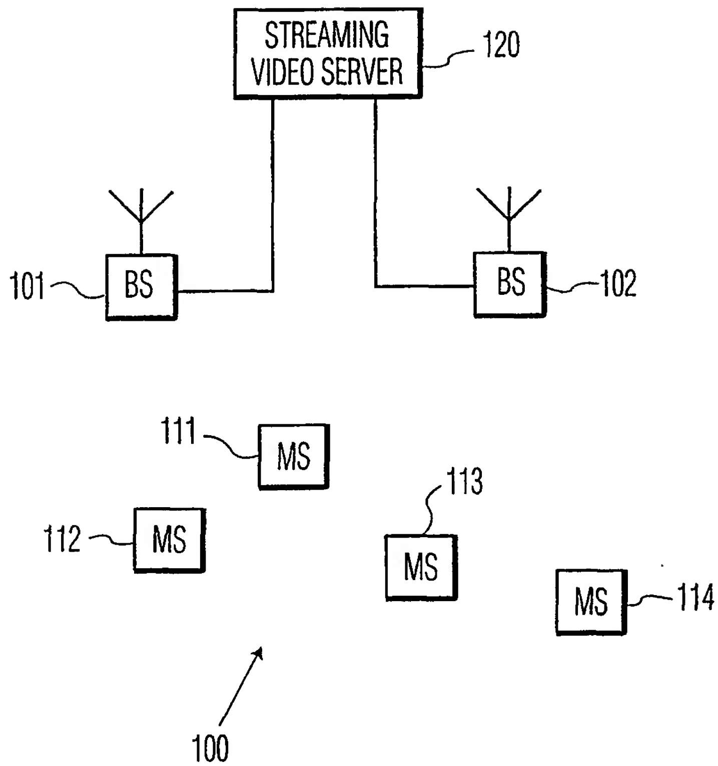
STREAMING VIDEO SERVER
120
101
BS
BS
102
111
MS
113
112
MS
MS
MS
114
100

FIG. 1

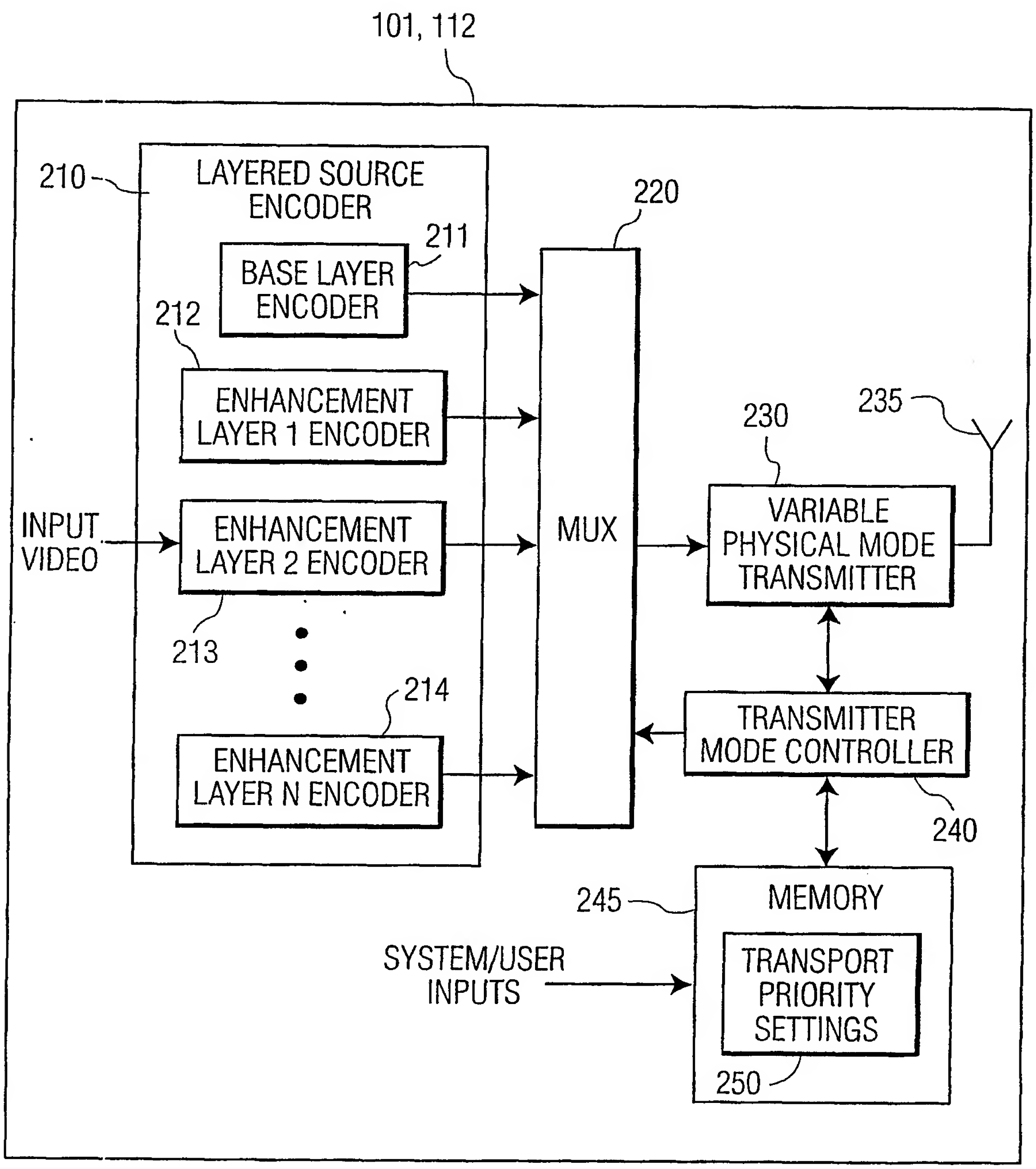
101, 112
210
LAYERED SOURCE ENCODER
211
BASE LAYER ENCODER
212
ENHANCEMENT LAYER 1 ENCODER
INPUT VIDEO
ENHANCEMENT LAYER 2 ENCODER
213
214
ENHANCEMENT LAYER N ENCODER
220
MUX
230
235
VARIABLE PHYSICAL MODE TRANSMITTER
TRANSMITTER MODE CONTROLLER
240
245
MEMORY
SYSTEM/USER INPUTS
TRANSPORT PRIORITY SETTINGS
250

FIG. 2

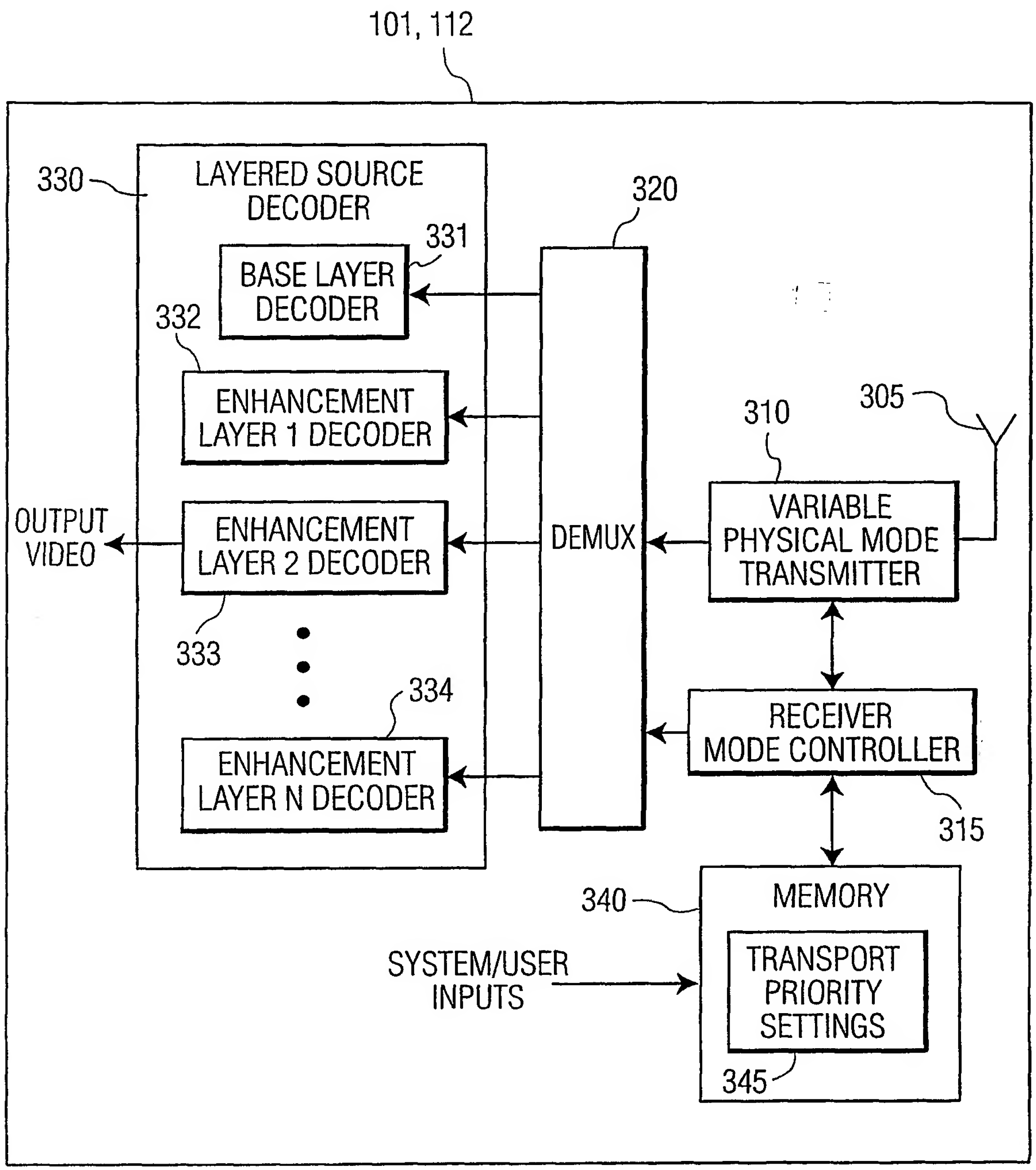
101, 112
330
LAYERED SOURCE DECODER
331
BASE LAYER DECODER
332
ENHANCEMENT LAYER 1 DECODER
OUTPUT VIDEO
ENHANCEMENT LAYER 2 DECODER
333
334
ENHANCEMENT LAYER N DECODER
320
DEMUX
310
305
VARIABLE PHYSICAL MODE TRANSMITTER
RECEIVER MODE CONTROLLER
315
340
MEMORY
SYSTEM/USER INPUTS
TRANSPORT PRIORITY SETTINGS
345

FIG. 3

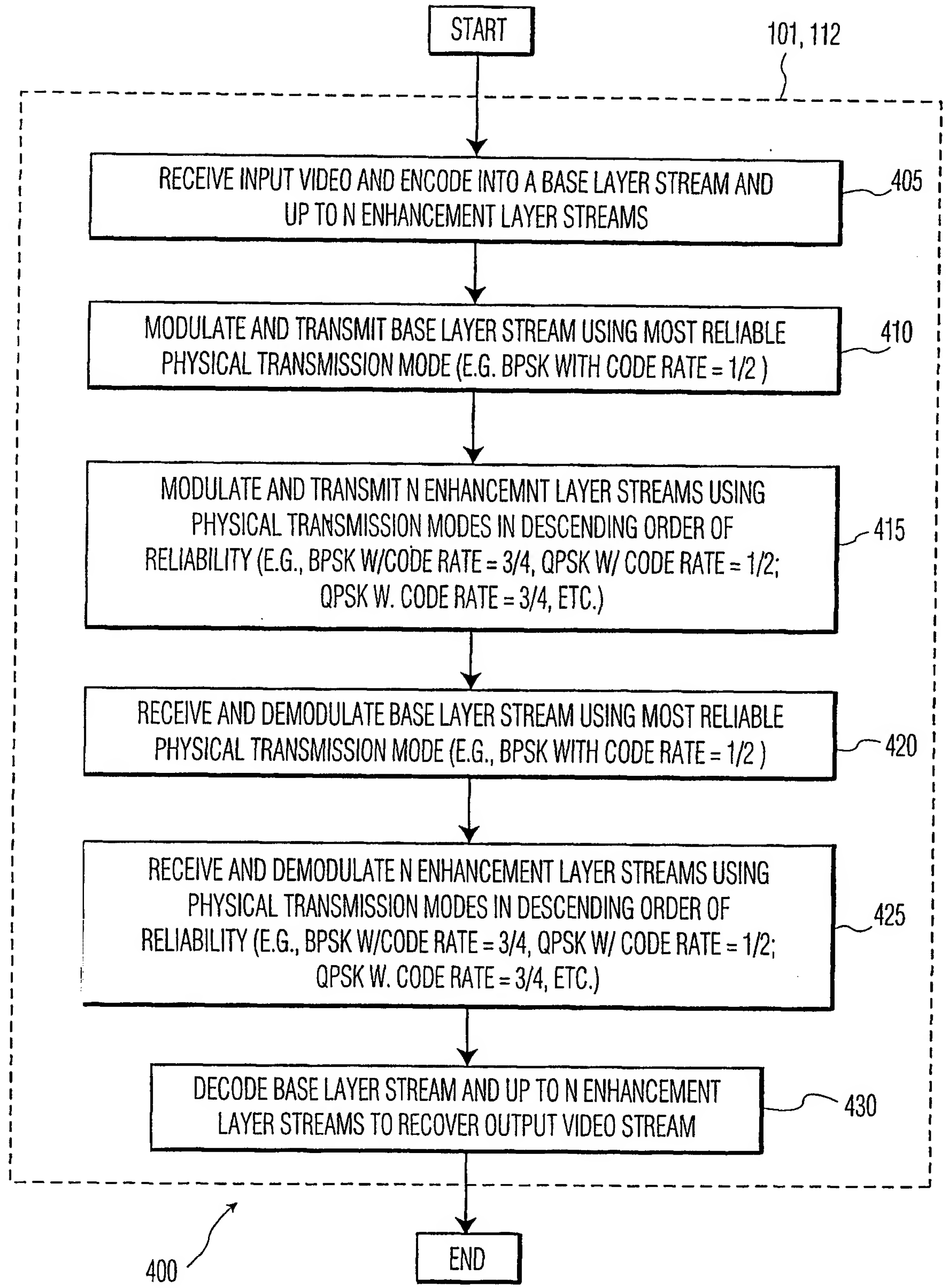
START
101, 112
RECEIVE INPUT VIDEO AND ENCODE INTO A BASE LAYER STREAM AND UP TO N ENHANCEMENT LAYER STREAMS
405
MODULATE AND TRANSMIT BASE LAYER STREAM USING MOST RELIABLE PHYSICAL TRANSMISSION MODE (E.G. BPSK WITH CODE RATE = 1/2)
410
MODULATE AND TRANSMIT N ENHANCEMNT LAYER STREAMS USING PHYSICAL TRANSMISSION MODES IN DESCENDING ORDER OF RELIABILITY (E.G., BPSK W/CODE RATE = 3/4, QPSK W/ CODE RATE = 1/2; QPSK W. CODE RATE = 3/4, ETC.)
415
RECEIVE AND DEMODULATE BASE LAYER STREAM USING MOST RELIABLE PHYSICAL TRANSMISSION MODE (E.G., BPSK WITH CODE RATE = 1/2)
420
RECEIVE AND DEMODULATE N ENHANCEMENT LAYER STREAMS USING PHYSICAL TRANSMISSION MODES IN DESCENDING ORDER OF RELIABILITY (E.G., BPSK W/CODE RATE = 3/4, QPSK W/ CODE RATE = 1/2; QPSK W. CODE RATE = 3/4, ETC.)
425
DECODE BASE LAYER STREAM AND UP TO N ENHANCEMENT LAYER STREAMS TO RECOVER OUTPUT VIDEO STREAM
430
400
END

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/01878

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 742 343 A (HASKELL BARIN GEOFFRY ET AL) 21 April 1998 (1998-04-21)	1,4,7,10
A	the whole document	2,3,5,6, 8,9,11, 12

Y	EP 0 928 084 A (MITSUBISHI ELECTRIC CORP) 7 July 1999 (1999-07-07)	1,4,7,10
A	column 3, line 19 -column 5, line 1	2,3,5,6, 8,9,11, 12

A	WO 99 33274 A (ROSE KENNETH) 1 July 1999 (1999-07-01) page 6, line 15 -page 12, line 31	1-12

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2001	20/07/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Greve, M

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/01878

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 05898 A (LI WEIPING ;OPTIVISION INC (US)) 3 February 2000 (2000-02-03) page 7, line 25 -page 9, line 5 -----	1-12

INTERNATIONAL SEARCH REPORT

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'EP 01/01878

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		EP 1071237 A	24-01-2001
		EP 1071238 A	24-01-2001
		JP 11284688 A	15-10-1999
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